

PERCUPUMP® *TOUCH*SCREEN*™

CT INJECTOR SYSTEM

Maintenance and Service Manual

**For Injector Systems with and without the Extravasation Detection
Accessory (Catalog Numbers 7805, 7806, 7815, and 7816)**

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Section 1

Introduction

1.1 SCOPE

The E-Z-EM PERCUPUMP *TOUCHSCREEN* is used in conjunction with computed tomography (CT) of the body and is intended for the administration of X-ray contrast media into the human vascular system. Injector systems that feature the Extravasation Detection Accessory (EDA), (US Patents # 5,964,703 and 5,947,910) also provide localized tissue monitoring over the injection site. This manual applies to Injector systems with catalog numbers 7805, 7806, 7815, and 7816 and provides preventive maintenance and inspection procedures to ensure proper operation of the PERCUPUMP *TOUCHSCREEN*. It also provides troubleshooting and repair procedures to be performed by an authorized service technician. All references to the EDA, however, apply only to units with catalog numbers 7805 and 7806. Disregard all EDA maintenance, inspection, troubleshooting, and repair procedures when servicing units with catalog number 7815 and 7816.

1.2 AUDIENCE

This manual is intended to be used by technical personnel familiar with working on medical electrical equipment. Individuals possessing some or all of the following qualifications should be able to understand and comprehend the content of this document:

- Hospital biomedical engineering staff
- CBMET, AAMI Certified Biomedical Engineering Technician
- Electronics technician possessing an Associates degree and two or more years working experience
- Individuals trained on this document by E-Z-EM staff

1.3 ORGANIZATION

This manual is organized into four sections and two appendixes:

1.3.1 Sections

- | | |
|--|---|
| 1: Introduction | Identifies the purpose and organization of the manual. |
| 2: Periodic Maintenance and Inspection | Provides maintenance and inspection procedures to ensure proper operation of the PERCUPUMP <i>TOUCHSCREEN</i> . |

- | | |
|--|---|
| 3: Troubleshooting | Identifies symptoms, self-test error codes and messages, and diagnostic procedures for isolating to faults. |
| 4: Disassembly and Reassembly Procedures | Provides instructions for removing and replacing failed components. |

1.3.2 Appendixes

- | | |
|---|---|
| Appendix A: Parts List | Identifies replaceable components and corresponding E-Z-EM part numbers. |
| Appendix B: Schematics and Printed Circuit Board Drawings | Provides schematics and printed circuit board drawings for the PERCUPUMP TOUCHSCREEN. |

1.4 RELATED DOCUMENTATION

MANUAL AND OPERATIONS GUIDE

Volume 1: Document No. 017-0057, Item No. 1471372
Volume 2: Document No. 017-0003, Item No. 1471309

1.5 MANUAL CONVENTIONS

This manual uses the following conventions:

- ◆ **Bold** indicates emphasis or heading.
- ◆ "Note" is used to set off important information from the rest of the text.
- ◆



CAUTION

The above graphic identifies a procedure that, if not properly followed, may result in the improper operation of the system.



WARNING

The above graphic identifies a procedure that, if not properly followed, may result in personal injury, death, or equipment damage.

1.6 WARNINGS



Observe the following warnings. Failure to comply may result in personal injury, death, or equipment damage.

1. Shock Hazard:

Lethal voltages are present. Use extreme care when servicing equipment with the AC/Mains power connected. Do not leave an open system unattended with AC/Mains Power connected. DISCONNECT THE AC/MAINS POWER CORD BEFORE REMOVING OR REPLACING COMPONENTS.

Make only proper electrical connections. Plug the unit directly into a grounded, hospital-grade for U.S. applications, 3-pronged outlet. Do not use an extension cord. Do not use an adapter to plug the unit into a two-pronged, non-grounded outlet. Replace any worn or frayed wires immediately.

2. Explosion Hazard:

A risk of explosion exists if used in the presence of flammable anesthetics. Never operate the PERCUPUMP TOUCHSCREEN in the presence of any flammable gases.

3. Equipment Safety:

Only connect the PERCUPUMP TOUCHSCREEN to an electrical source of the proper voltage and frequency. If an incorrect voltage is used, the Injector may be damaged when turned on.

The PERCUPUMP TOUCHSCREEN contains electrostatic sensitive components. You must wear a wrist grounding strap, and place components on an anti-static pad. Failure to comply may result in damage to the equipment due to electrostatic discharge.

1.7 UNAUTHORIZED MODIFICATION and REPAIRS

Unauthorized modifications to the PERCUPUMP TOUCHSCREEN will void your warranty.

Servicing of internal parts should only be performed by authorized personnel. Opening or servicing of the PERCUPUMP TOUCHSCREEN by unauthorized personnel may result in injury, death, or damage to equipment, and will void your warranty. Further such unauthorized opening or servicing will render null and void any other indemnities given by E-Z-EM in conjunction with the PERCUPUMP TOUCHSCREEN.

Section 2

Periodic Maintenance & Inspection

2.1 MAINTENANCE AND INSPECTION

Periodic maintenance and inspection procedures should be performed by qualified personnel only. Any service, maintenance, or safety inspections that are performed on the PERCUPUMP *TOUCHSCREEN* should be logged into the **SERVICE, MAINTENANCE, AND PERIODIC SAFETY AND INSPECTION LOG** provided in this section.

2.2 PERIODIC MAINTENANCE

Maintenance consists of cleaning the PERCUPUMP *TOUCHSCREEN* and should be performed on a regular basis or as needed. If it is not used for a prolonged period of time, it should be cleaned at least once every six months. Follow the directions in the **CLEANING AND STORAGE PROCEDURE** provided in this section.

2.3 ANNUAL INSPECTION

Inspection should be performed once every twelve months by qualified hospital personnel. Follow the procedure in the **PERIODIC INSPECTION AND SAFETY CHECKLIST** provided in this section. A copy of the checklist should be filled out and kept for hospital records. If the PERCUPUMP *TOUCHSCREEN* should fail any part of the inspection, remove it from operation.

2.4 SERVICE

Preventive maintenance and service must be performed by an authorized technician only who is completely familiar with the use, operation, and servicing of the PERCUPUMP *TOUCHSCREEN*. Unauthorized service may result in personal injury, damage to the system, and voiding of the warranty. Further such unauthorized opening or servicing will render null and void any other indemnities given by E-Z-EM in conjunction with the PERCUPUMP *TOUCHSCREEN*.

CLEANING AND STORAGE PROCEDURE

After each injection, remove and dispose of the Syringe in accordance with Section 6 of the Operator's Manual.

When the day's schedule of injections is complete, or in the event of accidental spills on the equipment, clean the injector and Remote Control by observing the following procedures:

1. Turn off power to the system by depressing the "o" on the "Power" rocker switch on the Injector Head.
2. Use a paper towel dampened with warm water to wipe any dirt or spilled fluids off of the Injector Head and Remote Control. Care must be taken not to get water inside either of these units.
3. Do not autoclave.
4. Do not submerge the Injector Head or Remote Control in water.
5. Do not use strong disinfectants, solvents, or cleansers.

When not in use, store the PERCUPUMP TOUCHSCREEN in a safe place, removed from extreme or quickly changing temperatures, dust, and the possibility of spills or other accidental damage.

In order to safeguard the personnel involved with servicing the PERCUPUMP TOUCHSCREEN which has the potential for coming into contact with potentially hazardous or infectious materials, the following procedures should be adhered to before servicing the system:

1. Personal protective equipment should be worn. This includes but not limited to gloves, appropriate protective clothing and eye protection devices.
2. Wipe down all exposed areas of the PERCUPUMP TOUCHSCREEN with paper towels soaked with 0.5% sodium hypochlorite with water (e.g. 10% solution of household bleach) or commercially available cleaner (e.g. Envirocide®) and allow the areas to air.
3. Remove and clean protective clothing and eye protection devices. Dispose of the used paper towels and gloves as Regulated Medical Waste.

PERCUPUMP TOUCHSCREEN INJECTOR SERIAL NUMBER _____
PERCUPUMP TOUCHSCREEN REMOTE SERIAL NUMBER _____
MODEL NUMBER _____
INJECTOR S/N: _____
REMOTE S/N: _____

DATE OF
INSPECTION _____

CUSTOMER NAME,
ADDRESS _____

PERSON PERFORMING
INSPECTION _____

SERVICE, MAINTENANCE, AND PERIODIC SAFETY AND INSPECTION LOG

DATE	SERVICE, MAINTENANCE OR INSPECTION PERFORMED COMMENTS	SIGNATURE

DIRECTIONS: All inspection steps must pass. DO NOT attempt to use the PERCUPUMP TOUCHSCREEN if it fails any step in this procedure. After completion, sign the SERVICE, MAINTENANCE, AND PERIODIC SAFETY AND INSPECTION LOG. Also sign and retain a completed copy of this checklist and retain with the *MANUAL AND OPERATIONS GUIDE*, or place on file with the hospital's biomedical department.

TEST PROCEDURES

1. VISUAL INSPECTION
2. ELECTRICAL TEST
3. FUNCTIONAL PERFORMANCE TEST

PERIODIC INSPECTION AND SAFETY CHECKLIST

VISUAL INSPECTION

Pass Fail

1. ☐ ☐ Inspect the PERCUPUMP *TOUCHSCREEN* Injector exterior case for physical damage, dents, holes, cracks, scrapes or scratches. Look for evidence of any missing screws or components.

Check the labeling, voltage/current requirements, and review the owner's manual, especially with regards to injury prevention as outlined in the warnings and caution statements contained in the manual and labeled on the device.

Check the fuses for proper value and type.
2. ☐ ☐ Inspect the Injector's membrane panel for any punctures or tears.
3. ☐ ☐ Inspect the Injector's Syringe Door for smooth opening and closing.
4. ☐ ☐ Insert an approved PERCUPUMP *TOUCHSCREEN* Syringe into the Injector's Pressure Jacket and close the Syringe Door to ensure the disposable set seats properly and the door closes.
5. ☐ ☐ Inspect the power cord for damage, bent prongs or a deformed connector.
6. ☐ ☐ Inspect the Head Clamp assembly with the Injector Head installed to ensure the Injector is securely mounted and properly oriented.
7. ☐ ☐ Inspect the Remote Control's exterior case for physical damage, dents, holes, cracks, scrapes or scratches. Look for evidence of any missing screws or components.
8. ☐ ☐ Inspect the Remote Control's touch screen for any punctures or tears.
9. ☐ ☐ Inspect the fifty-foot Remote's (50') cable, Injector's pigtail, and Remote's pigtail for damage, bent pins or deformed connectors.

NOTE: If defects are found during the course of these technical safety tests that could potentially interfere with proper PERCUPUMP *TOUCHSCREEN* operation or be dangerous to the patient and/or operator or third parties, remove the unit from operation immediately. Do not attempt to use it.

PERIODIC INSPECTION AND SAFETY CHECKLIST

ELECTRICAL TEST

CAUTION: These tests are inherently hazardous and should only be performed by qualified biomedical personnel. Proper precautions should be exercised when conducting such tests.

Pass

Fail

Electrical Inspection

A periodical electrical inspection by hospital biomedical personnel should be conducted as per established hospital protocol and the following:

Check electrical safety ground resistance, including the mains cord in accordance with DIN VDE 0751 Part 1/10.90:

Record measured value _____ milliOhms Tested By: _____

Check the enclosure leakage current in accordance with DIN IEC 601-1/VDE 0750 Part 1/05.82:

Record measured value _____ μ A Tested By: _____

Check the patient leakage current in accordance with DIN IEC 601-1/VDE 0750 Part 1/05.82:

Record measured value _____ μ A Tested By: _____

NOTE: If defects are found during the course of these technical safety tests that could potentially interfere with proper PERCUPUMP TOUCHSCREEN operation or be dangerous to the patient and/or operator or third parties, remove the unit from operation immediately. Do not attempt to use it.

PERIODIC INSPECTION AND SAFETY CHECKLIST

All questions and directions in italics apply only to Injector systems with EDA (catalog numbers 7805 and 7806). All other questions and directions apply to all Injector systems (catalog numbers 7805, 7806, 7815, and 7816).

FUNCTIONAL PERFORMANCE TEST

NOTE: The following procedure requires a syringe, 100 cc graduated cylinder, extension tube, and a stopcock.

1. Turn on "Power" switch to Injector. Is "Power" indicator on *and does the symbol (Ω) appear after pump self test is completed?* ☐Y or ☐N
2. Open the Syringe Door. Does the Injector front panel display "DOOR OPEN"? ☐Y or ☐N
3. Close the Syringe Door. Press the Forward Slow "<" button. Does Injector Ram move forward and do the yellow indicator lights flash? ☐Y or ☐N
4. Rotate the Injector to a fully vertical position. The "LOAD" indicator should illuminate. Press and hold the "REPLACE SYRINGE" button until four full beeps are heard. The Ram should fully retract. Open the Syringe Door and insert a syringe. Close the door and initialize the Injector by pressing and holding the "<<" button until four full beeps are heard. Load the syringe with 200 ml of water by pressing the ">>" button. Couple the stopcock and extension tube to the syringe. Remove all air bubbles. Set the Remote Control to the following settings:

Phase 1: Flow Rate: 0.5 ml/sec; Volume: 20 ml
Phase 2: Flow Rate: 3.0 ml/sec; Volume: 20 ml
Delay to Scan: 20 seconds

Tilt the Injector down until the "RUN" LED illuminates on the Injector. Orient the stopcock to direct flow into the graduated cylinder. *Disable the EDA by pressing the EDA softkey on the remote. Press the "ARM" button. Confirm EDA Disabled by pressing the EDA softkey again.* Press the "RUN" button on the Remote Control.

Does the RUN Indicator illuminate on the Remote Control? ☐Y or ☐N

Does the Phase 1 display become reverse video? ☐Y or ☐N

Does the Delay to Scan decrement? ☐Y or ☐N

Does the unit beep or voice occur after 20 seconds? ☐Y or ☐N

After two phases, how much fluid was dispensed into the graduated cylinder (should be 36 to 44 ml)?

_____ ml.

5. Change the Remote Control settings to the following:

Phase 1: Flow Rate: 1.8 ml/sec; Volume: 20 ml
Phase 2: Flow Rate: 4.4 ml/sec; Volume: 20 ml
Delay to Scan: 10 seconds

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

After two phases, how much fluid was dispensed into the graduated cylinder (should be 36 to 44 ml)?

_____ ml.

Does the unit beep or voice occur after 10 seconds? ☐Y or ☐N

6. Change the Remote Control settings to the following:

Phase 1: Flow Rate: 1.0 ml/sec; Volume: 20 ml
Phase 2: Flow Rate: 5.0 ml/sec; Volume: 20 ml
Delay to Scan: 10 seconds

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

After two phases, how much fluid was dispensed into the graduated cylinder (should be 36 to 44 ml)?

_____ ml.

Does the unit beep or voice occur after 10 seconds? ☐Y or ☐N

7. Change the Remote Control settings to the following:

Phase 1: Flow Rate: 3.5 ml/sec; Volume: 20 ml
Phase 2: Flow Rate: 0.25 ml/sec; Volume: 5 ml
Delay to Scan: 1 second

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

After two phases, how much fluid was dispensed into the graduated cylinder (should be 22 to 28 ml)?

_____ ml.

Does the unit beep or voice occur after 1 second? ☐Y or ☐N

8. Change the Remote Control settings to the following:

Phase 1: Flow Rate: 4.0 ml/sec; Volume: 10 ml
Phase 2: Flow Rate: 4.8 ml/sec; Volume: 10 ml
Delay to Scan: 2 seconds

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

After two phases, how much fluid was dispensed into the graduated cylinder (should be 16 to 24 ml)?

_____ ml.

Does the unit beep or voice occur after 2 seconds? ☐Y or ☐N

9. Clear Phase 2. Then change the Remote Control settings to the following:

Phase 1: Flow Rate: 2.0 ml/sec; Volume: 60 ml
Delay to Scan: 7 seconds

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

Does the Remote Control display "X ml too little fluid for procedure?" ("X" is a number from 6 to 44.) ☐Y or ☐N

Press the "Stop" button and change the Volume setting to 5 ml on the Remote Control.

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

Does the unit beep or voice occur after 7 seconds? ☐Y or ☐N

When the Injector stops, how much fluid was dispensed into the graduated cylinder (should be 4 to 6 ml)?

_____ ml.

10. Turn the stopcock to block flow. Change the Remote Control to the following settings:

Phase 1: Flow Rate: 2.5 ml/sec; Volume: 10 ml

Disable the EDA and press the "ARM" button. Confirm EDA Disabled. Press the "RUN" button on the Remote Control.

Does the Injector run a short time and then the overpressure indicator on Injector front panel lights? ☐Y or ☐N

Does the Remote Control display "Pump overpressure fault"? ☐Y or ☐N

Does the Remote Control beeper activate momentarily? ☐Y or ☐N

Does the Injector front panel display "OVERPRESSURE"? ☐Y or ☐N

Turn the stopcock to allow flow, relieving pressure in the line. Press the "Over PSI Reset" button on the Injector.

Does the "Over PSI Reset" button light extinguish and front panel message clear?
☐Y or ☐N

- 11. Remove the extension tube and stopcock. Press the "REPLACE SYRINGE" button to remove syringe. Re-initialize the Injector and retract the Injector Ram to the 150 ml position. Tilt the Injector down until the "RUN" LED illuminates. Change the Remote Control settings to the following:**

Phase 1: Flow Rate: 2.0 ml/sec; Volume: 140 ml
Delay to Scan: --seconds

Connect one of the supplied EDA Patches to the clip. Remove the EDA patch backing and place it on the underside of your forearm. Make sure that both the Injector Head and Remote Control indicates "Range OK" after several seconds.

Press the "ARM" followed by the "RUN" button on the Remote Control.

When the volume remaining counter reaches 100 ml, detach the EDA Patch from the clip leaving the patch on the forearm.

Does the Injector stop and indicate the warning "Check for Possible Extravasation" after a few seconds ?

☐Y or ☐N

Does the Volume Remaining counter indicate between 80 to 95 ml? ☐Y or ☐N

Press the "REPLACE SYRINGE" button to retract the ram.

Press the "STOP" button and power off the Injector.

Section 3

Troubleshooting

3.1 ORGANIZATION

This section provides troubleshooting techniques for detecting and identifying malfunctions in the PERCUPUMP TOUCHSCREEN Injector Head, the Remote Control, and the EDA. It consists of a Preliminary Diagnostic Procedure and Corrective Action Procedures for system failures. The system failures are divided into three failure detection categories consisting of Power Failure, Error Codes and Messages, and Fault Detection and Isolation. Each of these are discussed in the order that they would normally occur or be detected. (Reminder—disregard all references to the EDA when servicing Injector systems with catalog numbers 7815 and 7816.)

3.2 PRELIMINARY DIAGNOSTIC PROCEDURE

There may be times when a unit is suspected of a malfunction when, in fact, it is fully operational. This can be a result of human error, failure of other equipment, poor connections, and so on. Before attempting any repair action, follow the common sense procedure below. It will save time and avoid needlessly taking the unit apart.

1. Make several attempts to recreate the problem including powering down and powering up again. If the problem does not reoccur, return the system to operation.
2. If the unit fails to power up, check the voltage at the AC/Mains power source.
3. Make certain that the AC/Mains power cord is properly connected. Check for any damage to the cord.
4. Disconnect the AC/Mains power, and check the fuses and the voltage selector setting in the rear of the Injector.
5. Check the fifty-foot (50') Remote cable, the Injector's pigtail, and the Remote's pigtail for proper connections or damage.
6. Inspect the syringe for foreign substance or damage.

3.3 CORRECTIVE ACTION PROCEDURES

The purpose of each of the failure categories is to identify malfunctions and to provide repair procedures. When necessary, diagnostic procedures are provided to help the service technician isolate to the failed sub-assembly. Once the cause of the failure has been identified, the technician refers to Section 4—DISASSEMBLY & REASSEMBLY PROCEDURES which provides step-by-step instructions for its removal and replacement. Sometimes, more than one sub-assembly will be suspect. **DO NOT REMOVE ALL OF THE COMPONENTS AT THE SAME TIME.** Replace each sub-assembly one at a time, in the order that they are listed, and retest the system after each replacement. If the problem still exists after all repairs have been made, return the unit to the manufacturer.

The system failures are discussed in the order that they would be detected. Power Failure is discussed first since no other failures will be detected should this malfunction occur. This is followed by Error Codes and Messages. These are generated by the system's self-monitoring capability and occur upon powering up and during normal operation. Fault Detection and Isolation is saved for last. These are faults that will be detected by the user while the system is in operation or during inspection.



Electrostatic Sensitive Devices (ESD) are present. You must wear a wrist grounding strap and place components on an anti-static pad. Failure to comply may result in damage to equipment due to electrostatic discharge.

3.3.1 Power Failure

If nothing happens when power is applied, perform the following steps:

Required test equipment: Digital Voltmeter

1. Power down the unit and disconnect the AC/Mains power cord.
2. Check the AC/Mains power cord.
3. Check the voltage at the outlet.
4. Make certain that the voltage selector is at the proper setting (100V, 120V, 220V, or 240V).
5. Check the Injector fuses, and replace if necessary. Refer to Figure 4-1d. Fuses are located above the AC/Mains power cord receptacle in the rear. Pry off the cover with a small flat blade screwdriver.

Note: Fuses are rated 250 Volt, 2 Amp, slo-blo for 100V and 120V operation.

Fuses are rated 250 Volt, 1 Amp, Type T for 220V and 240V operation.

6. If any corrective action has been taken in the above steps, apply power to the unit and retest. If the problem still exists, **disconnect the AC/Mains power** and proceed to the next step.

7. Remove the Injector's front enclosure with power disconnected. Follow procedure called out in Section 4.2.1.
8. Select one set of **vertical pins** on the **"Power" rocker switch**, and use a voltmeter to perform a continuity test while opening and closing the switch. Refer to Figure 4-1c. Repeat this step for the other set of vertical pins. If either continuity test fails, replace the **"Power" rocker switch**; otherwise, proceed to the next step.
9. Connect the AC/Mains power cord to the unit and the power source, and power up the unit.
10. Table 3-1 shows the voltages across the transformer primary taps for each of the voltage selector settings. Verify the Injector's voltage selector setting, and use a voltmeter to make the proper measurement. Allow for variations due to variations in the line voltage. If the test fails, the Power Entry Module is suspect—return the unit to the manufacturer.

Voltage at Transformer's Primary Taps		
Voltage Selector Setting	Tap Numbers	Voltage Reading
100V	5 and 2	100VAC
120V	5 and 6, 1 and 3	120VAC
220V	5 and 2	220VAC
240V	5 and 3	240VAC

Table 3-1

11. Measure the voltage **18VAC** across **Tap #7** and **Tap #12** on the transformer's secondary side. Allow for variation due to variation in the line voltage. If the test fails, the transformer is defective—return the unit to the manufacturer. If the test passes, proceed to the next step.
12. Locate the voltage regulator shown in Figure 3-1 and use a voltmeter to measure **15VDC** to **19VDC** across pins **X** and **Y**. Pin **Y** is Ground/Earth and is the center pin.



Use extreme care in placement of voltmeter probes on the voltage regulator pins. A short circuit may result in extensive damage to the system.

Take the following action based on the measurement:

- a. If the measured voltage is within range, replace the Injector's main PCB.
 - b. If a voltage is present but is out of range, replace the Power Supply.
 - c. If no voltage is present, reset the circuit breaker located underneath the Power Supply Assembly, and repeat the measurement.
 - d. If there is still no voltage, replace the Power Supply.
13. If any corrective action has been taken in the above steps, power up the system and retest. If problem still exists, return the unit to the manufacturer.

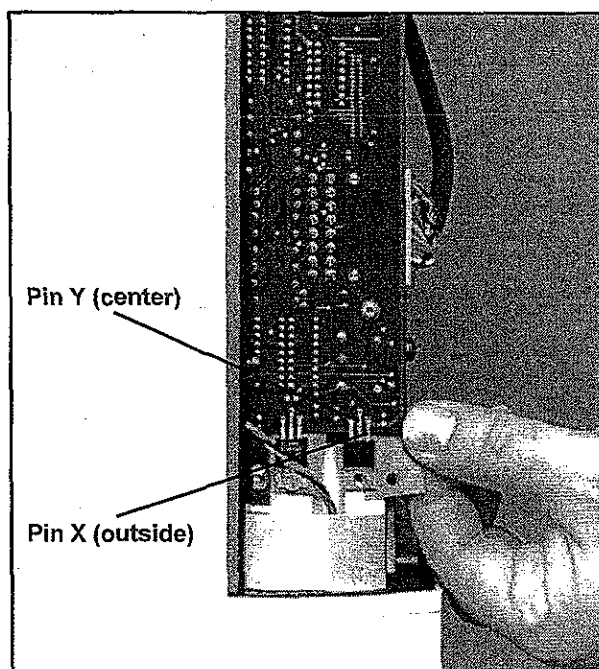


Figure 3-1: Voltage Regulator (Injector's Main PCB)

3.3.2 Error Codes and Messages

The PERCUPUMP *TOUCHSCREEN* has self-monitoring circuitry for detecting malfunctions in the Injector Head, Remote Control, and EDA. System self-test procedures are part of the initialization process that is activated when power is applied to the unit and continue to function during Injector operation. Injector Head malfunctions are displayed on its LCD as numeric codes, while Remote Control errors are displayed as messages on its LCD. The only exception is the single EDA error message which is displayed as a character string on the Injector Head and Remote Control LCDs. There is no numerical error code associated with the EDA.

3.3.2.1 Injector Head

The Injector Head's numerical error codes are shown as five-character displays on its LCD in the format "CC-SS". Error codes appearing in the "CC" fields are detected by the Injector's controller microprocessor, and error codes appearing in the "SS" fields are detected by the Injector's supervisor microprocessor. Whenever an error code appears in one field, the other field will always show zeros ("00"). Table 3-2 lists all of the error codes and indicates when these problems are detected—upon power up, in-process (during operation), or both. The table also provides a description of each error code. The last column identifies the Repair Action. Following the table, are all of the Repair Actions.

Table 3-2

Error Code #	Power Up	In Process	Description	Repair Action
01-00		X	Background EPROM CRC failure	A
02-00		X	RS-232 deadman Response Timer expired	B
05-00		X	Fine pulses exceeded 600	C
06-00		X	Remote run line dropped while in Run mode	B
08-00	X		RAM error	A
09-00	X		Powerup EPROM CRC failure	A
12-00	X	X	+5V Supervisor over voltage	A
13-00	X	X	+5V Supervisor under voltage	D
16-00		X	RS-232 Failure	B
17-00			Burn-in mode error/stopped	H
18-00		X	Remote run line high in stop	B
19-00	X		SPI failed in initialization	A
20-00	X	X	SPI failed in real-time	A
23-00	X	X	Shorted button Pump's front button	E
24-00	X		CPU test failure	A
25-00		X	Emergency stop, shorted pump button	F
26-00		X	SPI late with phase data	A
27-00		X	SPI error in phase data	A
28-00	X	X	+12V Controller over voltage	A
29-00	X	X	+12V Controller under voltage	A
30-00		X	Motor relay failure during replace	C
31-00		X	SPI msg. No. Failure	A
32-00	X		Start of relay initialization test	A

Table 3-2 (Continued on next page)

Section 3: Troubleshooting

33-00	X		Failure setting motor speed	C
34-00	X		Run forward command	C
35-00	X		Run reverse command	C
36-00	X		End of SPI initialization	A
37-00	X		"OK" at end of initialization not received from remote	A
38-00		X	AUTO-BURN IN mode selected	A
39-00	X		SPI H/W initialization completed	A
40-00	X		Initial SPI communications failure	A
60-00		X	SPI	A
61-00		X	Pulse Accum. Input Edge	C
62-00		X	Pulse Accum. Overflow	C
63-00		X	Timer Output Compare 2	A
64-00		X	Timer Input Capture 3	A
65-00		X	Timer Input Capture 2	A
66-00		X	Timer Input Capture 1	A
67-00		X	Real Time Interrupt	A
68-00		X	XIRQ	A
69-00		X	Illegal Opcode Trap	A
70-00		X	COP Failure	A
71-00		X	Cop Clock Monitor Failure	A
00-01	X		CRC error	A
00-02		X	CRC error	A
00-03	X	X	RAM error	A
00-04	X		CPU error	A

Table 3-2 (Continued on Next Page)

00-05	X		SPI at Power-Up	A
00-06		X	Too many fine pulses	C
00-08		X	Phase ran too long	C
00-09		X	stop error	C
00-10		X	STOP line debounce	B
00-11		X	SPI msg. Re-sync error	A
00-12	X	X	SPI msg. No. Error	A
00-13	X	X	+5V Controller over voltage	D
00-14	X	X	+5V Controller under voltage	A
00-15	X	X	SPI Comm. Failure	A
00-16		X	Motor forward direction error	C
00-17		X	Motor reverse direction error	C
00-19	X		CPU error	A
00-20		X	SPI messages too late or too soon	A
00-21		X	No SPI messages	A
00-22		X	Button press error	E
00-23		X	Motor moving in STOP mode	C
00-24		X	STOP button shorted in run mode	G
00-25		X	Remote run line high in run	G
00-26		X	Remote run line low in run	G
00-27	X	X	+12V Controller over voltage	D
00-28	X	X	+12V Controller under voltage	A
00-29		X	Phase running too long	C

3.3.2.1.1 Repair Action: A

Replace the Injector's main PCB and retest the unit. If the problem still exists, return the unit to the manufacturer.

3.3.2.1.2 Repair Action: B

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Inspect the fifty-foot (50') Remote cable for damage and replace if necessary.
2. Inspect the Remote's pigtail cable for damage and replace if necessary.
3. Inspect the Injector's pigtail cable for damage and replace if necessary.
4. Replace the Remote's main PCB.
5. Replace the Injector's main PCB.
6. Return the unit to the manufacturer.

3.3.2.1.3 Repair Action: C

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Check the Encoder Ribbon Cable connecting the Injector's motor to the Injector's main PCB. If the Encoder Ribbon Cable is damaged, replace the Injector's main PCB.
2. Replace the Injector's motor and encoder.
3. If the Injector's main PCB was replaced in Step 1, proceed to the next step; otherwise, replace the Injector's main PCB.
4. Return the unit to the manufacturer.

3.3.2.1.4 Repair Action: D

See Section 3.3.1—Power Failure.

3.3.2.1.5 Repair Action: E

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Check the Membrane Ribbon Cable connecting Injector's Membrane Panel and Injector's main PCB. Replace if necessary.
2. Replace the Injector's Membrane Panel with its PCB.
3. Replace the Injector's main PCB.
4. Return the unit to the manufacturer.

3.3.2.1.6 Repair Action: F

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Replace the Remote's Membrane Panel.
2. Replace the Remote's main PCB.
3. Return the unit to the manufacturer.

3.3.2.1.7 Repair Action: G

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Inspect the fifty-foot (50') Remote cable for damage and replace if necessary.
2. Inspect the Remote's pigtail cable for damage and replace if necessary.
3. Inspect the Injector's pigtail cable for damage and replace if necessary.
4. Replace the Remote's panel membrane.
5. Replace the Remote's main PCB.
6. Replace the Injector's main PCB.
7. Return the unit to the manufacturer.

3.3.2.1.8 Repair Action: H

Return the unit to the manufacturer.

3.3.2.2 Remote Control

The Remote Control generates error messages. Table 3-3 lists the applicable messages and indicates when these problems are detected—upon power up, in-process (during operation), or both. The last column identifies the Repair Action. Following the table, are all of the Repair Actions.

Note: These messages can occur during normal operation due to external influences or operator setup such as poor connections or kinks in tubing. First, eliminate the possibility of any external problems. If the error messages reoccur, proceed with the appropriate Repair Action.

Power Up	In Process	Message	Repair Action
	X	"Pump overpressure fault"	I
	X	"Tilt Pump Down to Continue"	J
	X	"Pump Door Open"	K
X	X	"Communications Error XX, Check Connections, Repower System"	L
	X	"X-RAY RELAY FAILED TO CLOSE"	M
X	X	"CRC Communications Failure, Check Connections, Repower System"	L
X		EPROM CRC error: CRC expected is XXXX, calculated CRC is YYYY	M

Table 3-3

Note: "X" and "Y" in Table 3-3 represent numerical digits in the Remote's display.

3.3.2.2.1 Repair Action: I

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Replace the Fast-Load Syringe.
2. Power down the unit and remove the Injector's front enclosure.
3. Refer to Figure 4-1c and inspect the Ball-Screw Assembly and the Anti-Rotation Bracket.
4. If there is any indication of damage, return the unit to the manufacturer.
5. Inspect for restriction or damage to the timing belt. Replace if necessary.
6. Attempt to move the Anti-Rotation Bracket backward and forward by turning the motor and timing belt with your hands. Refer to Figure 4-1d. If it is too difficult to move, return the unit to the manufacturer.
7. Replace the motor and encoder.
8. Return the unit to the manufacturer.

3.3.2.2.2 Repair Action: J

If the operator is directed to tilt the Injector Head (pump) when it is already tilted, this could be a result of defective tilt switches located in the Injector's Membrane Panel unit.

1. Replace the Injector's Membrane Panel with its PCB and retest the system.
2. If the problem still exists, return the unit to the manufacturer.

3.3.2.2.3 Repair Action: K

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Inspect the Syringe Door's magnet. If it is missing or damaged, return the unit to the manufacturer.
2. Replace the Hall Effect Sensor.
3. Return the unit to the manufacturer.

3.3.2.2.4 Repair Action: L

Shut off and re-apply power to the system several times. If the error message does not reoccur, the system is functional and may be returned to operation. If the problem reoccurs, perform the following procedure (retest the system after each step):

1. Inspect the fifty-foot (50') Remote cable for damage and replace if necessary.
2. Inspect the Remote's pigtail cable for damage and replace if necessary.
3. Inspect the Injector's pigtail cable for damage and replace if necessary.
4. Replace the Remote's main PCB.
5. Replace the Injector's main PCB.
6. Return the unit to the manufacturer.

3.3.2.2.5 Repair Action: M

After each step, retest the system. If the problem still exists, proceed to the next step.

1. If the Remote is connected to the CT Scanner, remove the connection and retest the unit. If the unit works, return it to operation and check the connections to the CT Scanner. If the unit fails, proceed to Step 2.
2. Replace the Remote's main PCB.
3. Return the unit to the manufacturer.

3.3.2.3 EDA

For Injector systems equipped with an EDA (catalog numbers 7805 and 7806), the Greek character Omega (Ω) appears with each Injector Head message in the right-most character field, and the "EDA" softkey appears in the Remote Control's Parameter Entry Screen. Their presence indicate that the EDA is functioning. They do not indicate, however, whether or not the EDA is enabled.

When the Injector's self-test detects an EDA malfunction, the message "EDA INOPERABLE" is displayed on the Injector Head LCD and the Remote Control LCD. In addition, the Omega character and the "EDA" softkey will be missing from the Injector Head and Remote Control displays, respectively. When this occurs, power down and power up the system several times. If the error message does not reoccur, the system is functional and may be returned to operation. If

the problem reoccurs, perform the following procedure:

After each step, retest the system. If the problem still exists, proceed to the next step.

Required test equipment: Digital Voltmeter

1. Power down the unit, remove the EDA pod cover and disconnect the J2 connector from the EDA PCB.
2. The EDA PCB Harness connects the EDA PCB (J1) and the Injector's main PCB. Disconnect the EDA PCB Harness (J1 connector) from the EDA PCB (see Figure 4-7a) and the Injector's main PCB (see Figure 4-1a). Perform continuity tests on the EDA PCB Harness and check for shorts between wires and between each wire and Ground/Earth. Replace the EDA PCB Harness if necessary.
3. Replace the EDA PCB.
4. Replace the Injector's main PCB
5. Return the unit to the manufacturer.

Note: Do not use excessive force or pull on the wires to disconnect the J1 and J2 connectors from the EDA PCB or the EDA PCB Harness Connector from the Injector's main PCB. Pull slightly back on the connector away from the locking mechanism, and wiggle the connector off the connector receptacle (see Figure 3-2).

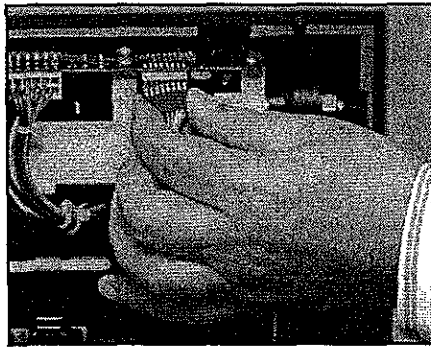


Figure 3-2: Removing a Methode Connector

3.3.3 Fault Detection and Isolation

The following identifies failures that would occur during normal operation or inspection and would be detected by the user.

3.3.3.1 Injector LCD Stuck at Software Revision Display

If the Injector's LCD appears to be stuck at the software revision display, it is because the Injector/Remote RS-232 communications handshake did not occur. Reapply power and observe the Injector's LCD. If "INITIALIZE" or "0 ml" is displayed, the Injector is good and may be

returned to operation. If the problem reoccurs, and the LCD gets stuck at the software revision display, perform the following procedure (retest the system after each step):

1. Inspect the fifty-foot (50') Remote cable for damage and replace if necessary.
2. Inspect the Remote's pigtail cable for damage and replace if necessary.
3. Inspect the Injector's pigtail cable for damage and replace if necessary.
4. Replace the Remote's main PCB.
5. Replace the Injector's main PCB.
6. Return the unit to the manufacturer.

3.3.3.2 Injector's Syringe Warmer Does Not Get Warm

After each repair or replacement, retest the system. If the problem still exists, proceed to the next step.

Required test equipment: Digital Voltmeter

1. Power down the Injector and replace the Syringe Warmer. Proceed to the next step to test replacement.
2. Power up the Injector.
3. Rotate the Injector Head to a fully vertical position.
4. Press and hold the "<<" button for three seconds (you will hear four beeps). This will engage Auto Initialize.
5. Wait until the Ram has stopped (at 0 ml), then press and hold the "REPLACE SYRINGE" button for three seconds (you will hear four beeps).
6. Wait until the Ram has stopped, then press the "<<" button.
7. Allow the Ram to advance a short distance then stop it by pressing any front panel button.
8. Tilt the Injector downward and wait five minutes. The Syringe Warmer should become warm to the touch.
Note: The Syringe Warmer will automatically turn off after sixty (60) minutes and begin cooling down.
9. If the replaced Syringe Warmer fails to warm up, power down the Injector and disconnect the Syringe Warmer cable from the Injector receptacle.
10. Figure 3-3(a) is a front view of the Injector receptacle. Pin A is Ground/Earth. Perform a continuity test between pin A and a good Ground/Earth on the Injector. If the test fails, replace the Syringe Warmer Harness and retest the unit; otherwise, proceed to the next step.
11. Connect the Syringe Warmer cable to the Injector and repeat Steps 2 through 7.
13. Tilt the Injector downward.
14. Disconnect the Syringe Warmer cable. Measure +12VDC across pin B (+) and pin C (-) in the Injector receptacle shown in Figure 3-3. If the test passes, power down the Injector and replace the Syringe Warmer (original replacement is defective); otherwise, proceed to the next step.
15. Power down the Injector. Remove the Injector's front enclosure, and disconnect the 12-pin Molex connector at the rear of the Injector.
16. Perform continuity tests on the harness and check for shorts between wires and between each wire and Ground/Earth. If any test fails, replace the Syringe Warmer Harness; otherwise, proceed to the next step.

Note: Green wire connects pin A to the Ground/Earth stud.

Red wire connects pin B (+) to pin 12 on the 12-pin Molex connector.

Black wire connects pin C (-) to pin 1 on the 12-pin Molex connector.

17. Replace Injector's main PCB.

18. If the problem still exists, return the unit to the manufacturer.

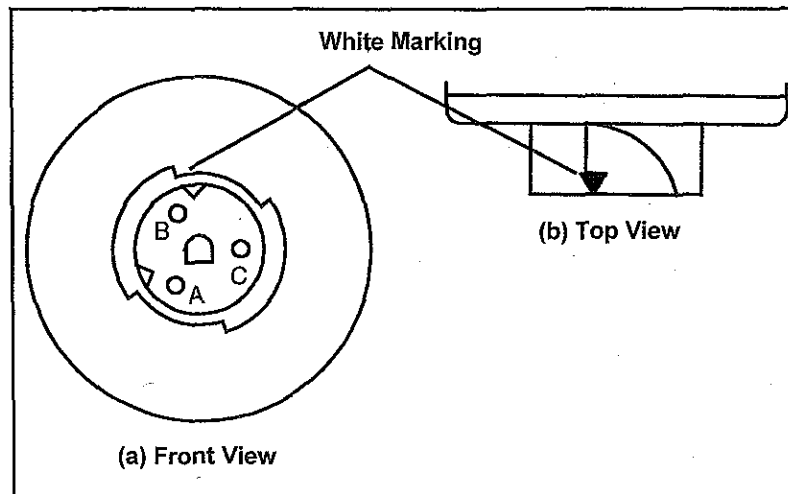


Figure 3-3: Syringe Warmer Receptacle

3.3.3.3 Injector's Tone Device (Annunciator) Does Not Sound

Power up the unit. The Tone device will beep during initialization. If no sound is heard, replace the following components and retest after each replacement:

1. Injector's Tone Device.
2. Injector's main PCB.
3. If the problem still exists, return the unit to the manufacturer.

3.3.3.4 Injector's LCD Displays Nothing or Garbled Information

Confirm that the Remote's LCD is working properly. If the Remote's LCD is good, replace the Injector's Membrane Panel with its PCB and retest. If problem still exists, return the unit to the manufacturer.

If the Remote's LCD also displays nothing or garbled information, check all power connections.

3.3.3.5 Injector's LEDs Do Not Illuminate

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Check the ribbon cable connecting the Injector's front panel PCB and the Injector's main PCB. Replace if necessary.
2. Replace the Injector's Membrane Panel with its PCB.
3. Replace the Injector's main PCB.
4. Return the unit to the manufacturer.

3.3.3.6 Remote's LEDs Do Not Illuminate

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Replace the Remote's Membrane Panel.
2. Replace the Remote's main PCB.
3. Return the unit to the manufacturer.

3.3.3.7 Remote's LCD Displays Nothing or Garbled Information

Confirm that the Injector's LCD is working properly. If the Injector's LCD indicates successfully passing power up diagnostics, replace the following components in the Remote and retest after each replacement:

1. Replace the Remote's LCD.
2. Replace the LCD Driver (the small PCB mounted on the Remote's main PCB).
3. Replace the Remote's main PCB.
4. If the problem still exists, return the unit to the manufacturer.

If the Injector's LCD also displays nothing or garbled information, check all power connections.

3.3.3.8 Pendant Switch Not Functioning While Connected to Injector

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Disconnect the Pendant Switch from the Injector, and connect it to the Remote's Pendant Switch Port. Attempt to start and stop the Ram using the Pendant Switch. If the problem still exists, replace the Pendant Switch.
2. Replace the Injector's Pendant Switch Module.
3. Replace the Injector's main PCB.
4. If the problem still exists, return the unit to the manufacturer.

3.3.3.9 Pendant Switch Not Functioning While Connected to Remote

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Disconnect the Pendant Switch from the Remote, and connect it to the Injector's Pendant Switch Port. Attempt to start and stop the Ram using the Pendant Switch. If the problem still exists, replace the Pendant Switch.
2. Replace the Remote's Pendant Switch Module. (See Figure 4-5b).
3. Replace the Remote's main PCB.
4. If the problem still exists, return the unit to the manufacturer.

3.3.3.10 Remote's Printer Not Functioning

After each step, retest the system. If the problem still exists, proceed to the next step.

1. Inspect the printer cable and replace if necessary.
2. Swap printers.
3. Replace the Remote's Printer Module. (See Figure 4-5b.)
4. Replace the Remote's main PCB.
5. If the problem still exists, return the unit to the manufacturer.

3.3.3.11 EDA Cannot Establish Baseline and/or System Displays Range Error Messages

Prior to placement of the Extravasation Detection Patch on the patient, the Injector Head and Remote Control LCDs will show range error messages. Upon placement of the patch on the patient, the EDA will establish a baseline. During this time, the Injector Head will display "xxxmL BASE ERR Ω" ("xxx" represents the contrast volume in the syringe), and the Remote Control will display "EDA Enabled - No Baseline". Once a baseline is established, the Injector Head and Remote Control LCDs will display "xxxmL RANGE OK Ω" and "EDA Enabled - Range OK", respectively.

The diagnostic procedure below, applies for the following conditions:

- ◆ The EDA is functional (the Injector Head and Remote Control do not display "EDA INOPERABLE"), and
- ◆ The EDA cannot establish a baseline, and/or
- ◆ The Injector Head and Remote Control continue to display range error messages after the Extravasation Detection Patch has been placed on the patient.

Note: The system will not arm if range errors are displayed.

After each repair or replacement, retest the system. If the problem still exists, proceed to the next step.

Required test equipment: Digital Voltmeter

1. Replace the Extravasation Clip Assembly and retest.
2. Power down the unit, remove the EDA pod cover and disconnect the J2 connector from the EDA PCB.
3. The Locking Receptacle Assembly is on EDA pod cover. One end is the receptacle for the Extravasation Clip Assembly; the other end is the J2 connector on the EDA PCB. Perform continuity tests on the Locking Receptacle Assembly (between the J2 connector and the receptacle for the Extravasation Clip Assembly Connector). Also check for shorts between wires and between each wire and Ground/Earth. Replace the Locking Receptacle Assembly if necessary.
4. Replace the EDA PCB.
5. Return the unit to the manufacturer.

Note: Do not use excessive force or pull on the wires when disconnecting the J2 connector from the EDA. Pull slightly back on the connector away from the locking mechanism, and wiggle the connector off the connector receptacle (see Figure 3-2).

3.3.3.12 Missing EDA Softkey and Omega (Ω) Character

The presence of the Greek character Omega (Ω) on the Injector Head LCD and the “EDA” softkey in the Remote Control’s Parameter Entry Screen indicate that the EDA is functioning.

The diagnostic procedure below, applies for the following conditions:

- ◆ The Injector Head and Remote Control do not display “EDA INOPERABLE”, and
- ◆ The Omega (Ω) Character is missing from the Injector Head LCD, and
- ◆ The “EDA” softkey is missing from the Remote Control’s Parameter Entry Screen.

Note: If the base Injector system is operational, it can be used without the EDA by disabling the EDA function (press the “EDA” softkey on the Remote Control).

After each repair or replacement, retest the system. If the problem still exists, proceed to the next step.

Required test equipment: Digital Voltmeter

1. Power down the unit, remove the EDA pod cover and disconnect the J2 connector from the EDA PCB.
2. Check the J1 connector on the EDA PCB Harness for proper connection to the EDA PCB. Retest.
3. Remove the Injector’s front enclosure and check the EDA PCB Harness Connector for proper connection to the Injector’s main PCB. Retest.
4. Disconnect the EDA PCB Harness (J1 connector) from the EDA PCB (see Figure 4-7a) and the Injector’s main PCB (see Figure 4-1a). Perform continuity tests on the harness and check for shorts between wires and between each wire and Ground/Earth. Replace the EDA PCB Harness if necessary.
5. Replace the EDA PCB.
6. Replace the Injector’s main PCB.

7. Return the unit to the manufacturer.

Note: Do not use excessive force or pull on the wires to disconnect the J1 and J2 connectors from the EDA PCB or the EDA PCB Harness Connector from the Injector's main PCB. Pull slightly back on the connector away from the locking mechanism, and wiggle the connector off the connector receptacle (see Figure 3-2).

Section 4

Disassembly & Reassembly Procedures

4.1 ORGANIZATION

This section is divided into three parts—Injector Head, Remote Control, and EDA. It provides instructions for removing and replacing failed components that have been identified in Section 3. All references to the EDA or EDA components apply only to Injector systems with catalog numbers 7805 and 7806 and should be disregarded for all other systems. Each procedure is structured as follows:

- ◆ Title—identifies the component to be replaced.
- ◆ Required Tools—identifies the tools needed.
- ◆ Removal Procedure—step-by-step instructions for removing the component.
- ◆ Replacement Procedure—step-by-step instructions for replacing the component.

Note: Always read the Replacement Procedure carefully. Although it is often the reverse of the Removal Procedure, there are some exceptions.



Lethal voltages are present. Before attempting disassembly you must power down the system and remove the AC/Mains power cord from the power source. Failure to comply may result in serious personal injury or death.

Electrostatic Sensitive Devices (ESD) are present. You must wear a wrist grounding strap and place components on an anti-static pad. Failure to comply may result in damage to equipment due to electrostatic discharge.

Use the following precautions when working on the system:

- ◆ Use caution when removing the Injector's front enclosure, the EDA Pod Cover, or the Remote Control's top enclosure. There are wires and cables that must be disconnected when separating the cover and enclosures.

- ◆ When cutting wire ties, cut the top of locking tab to avoid damaging the wires with cutters.
- ◆ Do not force the Injector's front enclosure shut. Resistance may be due to bunching of wires at the 12-pin and 16-pin Molex connectors on the Injector's Main PCB. Forcing the enclosure may result in damage to wiring.

4.2 INJECTOR HEAD

Refer to Figures 4-1a, 4-1b, 4-1c, and 4-1d for locating components to be removed or replaced in the Injector Head.

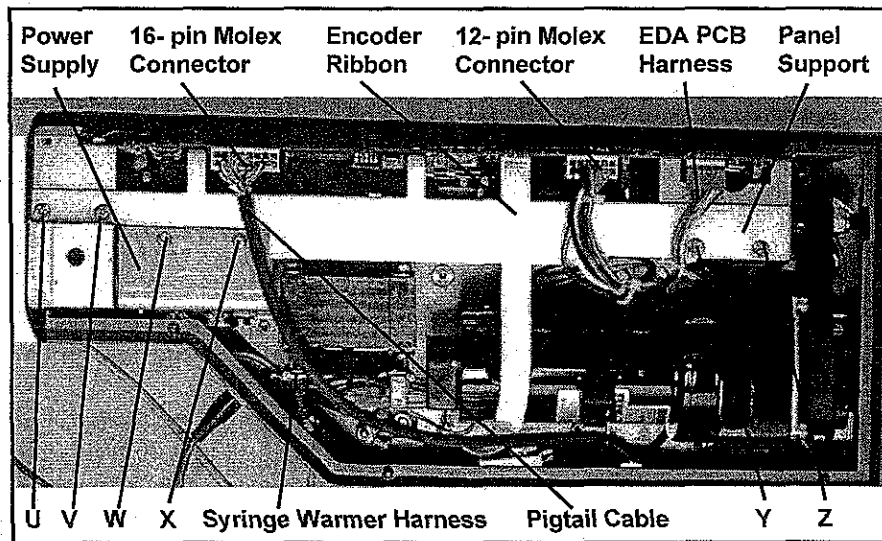


Figure 4-1a: Injector Head (Front Enclosure Removed)

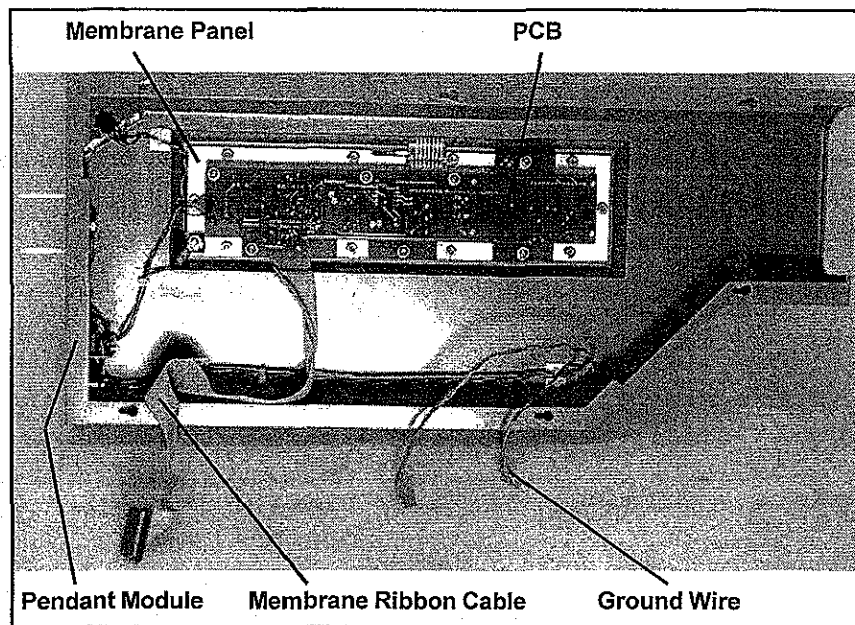


Figure 4-1b: Inside Injector Head's Front Enclosure

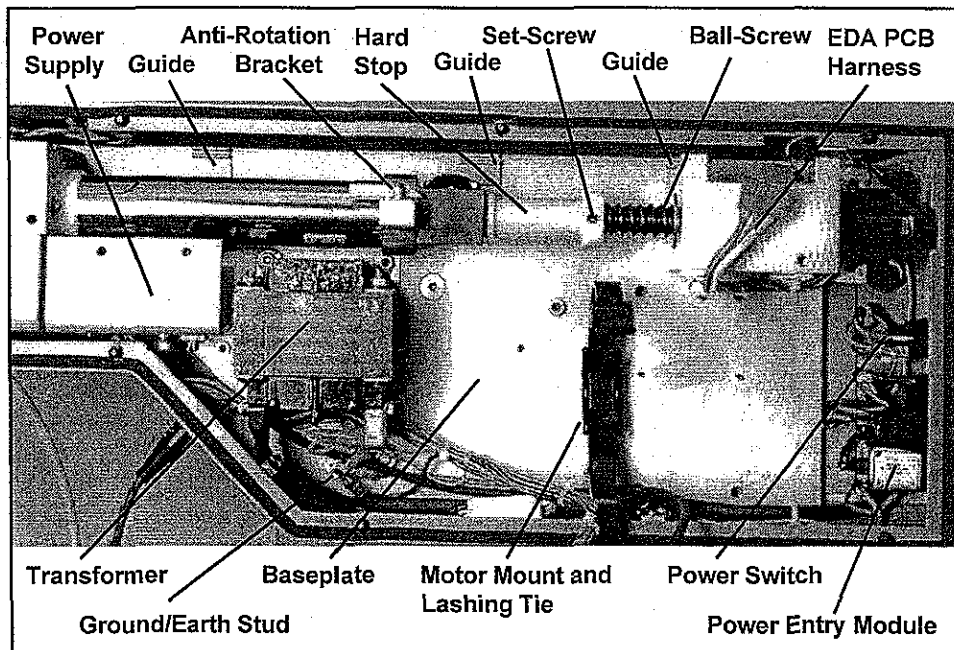


Figure 4-1c: Inside the Injector Head

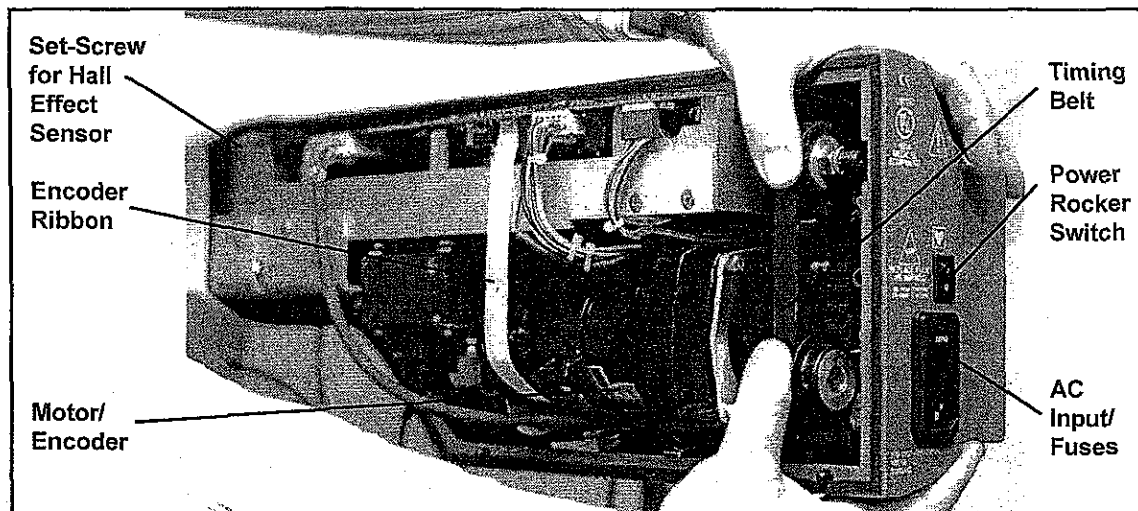


Figure 4-1d: Adjusting the Timing Belt

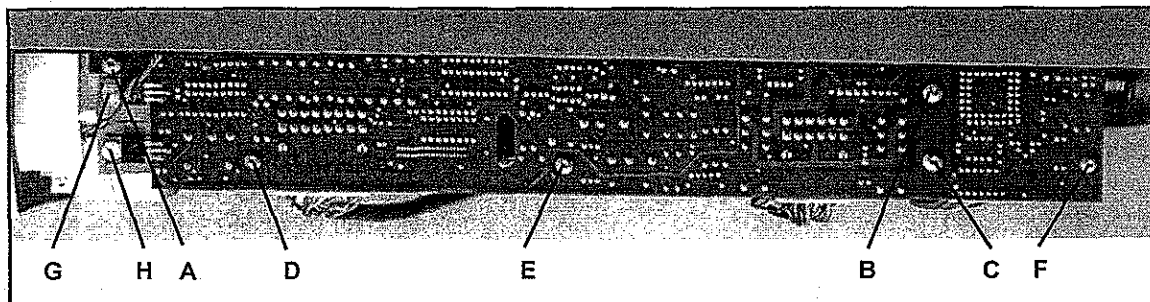


Figure 4-1e: Injector's Main PCB

4.2.1 Removing Injector's Front Enclosure

Refer to Figures 4-1b, 4-1c, and 4-2a and 4-2b.

4.2.1.1 Required Tools

- ◆ 7/64" balldriver or Allen wrench
- ◆ 11/32" nut driver

4.2.1.2 Removal Procedure

1. **Power down the unit and disconnect the AC/Mains power cord from the power source.**
2. Open the Syringe Door by pressing the quick-release latch and swinging the door open.
3. Use the 7/64" balldriver to remove the screw located above the Ram (see Figure 4-2a).
4. Close the Syringe Door by pivoting upward. This will prevent the Syringe Door from interfering.
5. While holding the unit with the right hand, gently tap on the bottom of the front enclosure with the left hand until it loosens (see Figure 4-2b).

6. Carefully separate the front enclosure from the Injector. They are connected with cables and wires. It may be necessary to push down on the top of the rear enclosure to disengage its pins from the front enclosure.



WARNING

There are wires and cables connecting the front enclosure to the Injector Head. Slowly remove the front enclosure and leave enough room to insert your hand to disconnect them. Failure to comply may result in equipment damage.

7. Gently remove the ribbon connector (ribbon cable from the front enclosure to the main PCB—see Figure 4-1b) from the main PCB. Squeeze the locking tabs on each side of the connector while removing.
8. Remove the plug connector for the **green** and **red** wires from the main PCB (see Figure 4-1b). Carefully pull down and out.
9. Refer to Figure 4-1c and locate the Ground/Earth stud beneath the transformer. Use the 11/32" nut driver to remove the hex nut and washers. Disconnect the front enclosure's ground wire—**green with yellow stripe**—from the Ground/Earth stud (see Figure 4-1b).
10. Replace the hex nuts, and washers to secure the remaining ground wires.



Figure 4-2a: Front Enclosure Securing Screw



Figure 4-2b: Removing the Injector's Front Enclosure

4.2.1.3 Replacement Procedure

1. Use the 11/32" nut driver to remove the hex nut and washers from the Ground/Earth stud beneath the transformer. Connect the green with yellow striped wire (ground) to the stud. Replace the washers and hex nut. Tighten the hex nut.
2. Connect the green and red wires' plug connector to the plug receptacle on the main PCB. It is keyed to ensure proper connection.
3. Connect the ribbon connector to the main PCB. It is keyed to ensure proper connection. Insert the ribbon connector so that the ribbon is coming out of the bottom of the connector.
4. Position the front enclosure so that its slots are aligned with the pins on the rear enclosure. Engage the pins into the slots.
Make sure that no internal wires are sticking out. Also make certain that the wires on the 12-pin and 16-pin Molex connectors are spread out and lie flat against the connectors. If the wires are allowed to bunch up, you will encounter resistance when trying to replace the front enclosure.
5. Holding the front enclosure with the left hand, tap it into place with the right hand. The front enclosure should be firmly seated and flush with the rear enclosure.



WARNING

Do not force front enclosure shut. If you encounter resistance, check the 16-pin and 12-pin Molex connectors. Forcing the front enclosure will result in equipment damage.

6. Open the Syringe Door by pressing the quick-release latch and swinging the door open.
7. Insert the screw that secures the front enclosure just above the Ram. Turn the screw clockwise until it engages the Injector's front enclosure and tighten with the 7/64" balldriver. Be careful not to over tighten.
8. Close the Syringe Door.

4.2.2 Replacing Injector's Main PCB

Refer to Figure 4-1e.

4.2.2.1 Required Tools

- ◆ 5/64" balldriver or Allen wrench
- ◆ 3/32" balldriver or Allen wrench
- ◆ Medium size flat blade screwdriver

Note: If the software revision is 2.30a or higher, the system will require a table pointer for the overpressure detection. See maintenance mode (section 4.5) before removal of PCB.

4.2.2.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1).
2. Ensure that the Anti-Rotation Bracket is positioned in front of the Encoder Ribbon Connector. If necessary, keep pushing down on the timing belt in the rear of the unit. This will cause the Ball-Screw Assembly to move forward (see Figure 4-1d).
3. Disconnect the 16-pin Molex connector and the 12-pin Molex connector. Press on the pin underneath the connector and gently move the connector back and forth to disconnect.
4. Disconnect the EDA PCB Harness Connector by slightly pulling outward and gently wiggling it off the connector receptacle (see Figure 3-2). Do not force or pull on the wires.
5. Disconnect the Encoder Ribbon Connector by pulling the connector down from the bottom of the encoder located on the motor. **Note the orientation of the connector on the encoder.**
6. Insert the 5/64" balldriver into the set-screw of the Hard Stop (see Figure 4-1c). Loosen the set-screw by turning it one or two times counter-clockwise.
7. With your finger, push the Hard Stop forward until it clears the capacitor on the Injector's main PCB. This will allow for easy removal of the PCB.
8. Use the 3/32" balldriver to remove the three (3) button-head screws labeled A, B, and C in Figure 4-1e.
9. Use the 5/64" balldriver to remove the three (3) button-head screws labeled D, E, and F.
10. Remove the clear insulating cover from the top of the PCB. Put it in a safe place and keep it clean.
11. Use the flat blade screwdriver to remove the two nylon screws labeled G and H. Save the locking washers and the insulating pads beneath the voltage regulators (see Figure 3-1).
12. Gently lift the PCB and slide it out part of the way. Be careful not to get stuck on other wires and components.
13. Locate the **red and black** wires located at the back of the Injector. Lift and slide out their plug connector from the plug receptacle on the PCB.
14. Locate the **red, black, and blue** wires located at the front of the Injector. Lift and slide out their plug connector from the plug receptacle on the PCB.
15. Remove the PCB and place on an anti-static pad.

4.2.2.3 Replacement Procedure

1. Locate the three (3) PCB guides on the baseplate inside the Injector. The PCB must be fully inserted into these guides. Refer to Figure 4-1c.
2. Partially insert the PCB into the Injector.
3. Locate the red and black wires at the back of the Injector. Connect their plug connector to the plug receptacle on the PCB.
4. Locate the red, black, and blue wires at the front of the Injector. Connect their plug connector to the plug receptacle on the PCB.
5. Make certain that the Hard Stop has been moved forward and is clear of the PCB's capacitor.
6. Make certain that the top of the PCB is clean of any foreign particles, and place the clear insulating cover on top of the PCB. The five (5) holes on the insulator must line up with the holes on the PCB to receive button-head screws A, B, C, D, E, and F.
7. Insert the PCB and its cover. The PCB must be fully inserted into the three guides that were located in Step 1 or the screw holes will not align.
8. Insert the insulating pads beneath the regulators (see Figure 3-1). The long side of each pad points towards the rear of the Injector.
9. Use the flat blade screwdriver to replace the nylon screws (G and H) and their locking washers.



Carefully inspect PCB and remove all foreign particles before placing the clear insulating cover on top of the PCB. Failure to ensure that the PCB is clean may result in damage to the Injector.

10. Use the 5/64" balldriver to replace the button-head screws D, E, and F.
11. Use the 3/32" balldriver to replace the button-head screws A, B, and C.
12. With your finger, push the Hard Stop all of the way back on the Ball-Screw Assembly.
13. Insert the 5/64" balldriver into the set-screw of the Hard Stop. Turn the set-screw clockwise until Hard Stop is secure. Do not over tighten.
14. Connect the Encoder Ribbon Connector to the bottom of the encoder. Note the number "1" on the connector. It must be positioned toward the inside of the Injector.



Do not reverse the connector on the encoder. This may damage the encoder.

15. Reconnect both Molex connectors. A snap will be heard when proper connection is made.
16. Reconnect the EDA PCB Harness Connector.
17. Push up the timing belt at rear of the Injector until the Ram is fully retracted.
18. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure.

4.2.3 Replacing Injector's Motor and Encoder

Refer to Figures 4-1a and 4-1c.

4.2.3.1 Required Tools

- ◆ 3/16" balldriver or Allen wrench
- ◆ Small size flat blade screwdriver
- ◆ Molex pin extraction tool—Part No. 11-03-0038 CT or equivalent
- ◆ Wire cutters
- ◆ Replacement wire tie

Note: If the software revision is 2.30a or higher, the system will require a table pointer for the overpressure detection. See maintenance mode (section 4.5) after replacement of motor assembly.

4.2.3.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
2. Disconnect the 12-pin Molex connector.
3. Disconnect the Encoder Ribbon Connector by pulling the connector down from the bottom of the encoder located on the motor. **Note the orientation of the connector on the encoder.**
4. Use the Molex pin extraction tool to remove the **black and white** motor wires from the Molex connector—pins 9 and 10. Insert the tool into the connector and push down. The tool's prongs should be on the outside of the square pin. A click will be heard when the pin is released. Gently pull out the wire.
5. Use the wire cutters to cut the wire tie holding the motor wires to the other Molex wires. **Note the position of the tie for replacement purposes.**
6. Turn the black lashing tie (strap) that is holding the motor until the tab is accessible. The lashing tie secures the motor to the motor mount and prevents the motor from vibrating.
7. Use the small flat blade screwdriver to lift the tab. This will cause the lashing tie to open. If you cannot open it, cut the lashing tie with wire cutters.
8. Use the 3/16" balldriver to remove the four (4) screws and locking washers that secure the motor bracket to the baseplate. The baseplate is located inside the Injector's rear enclosure.
9. The motor bracket has two holes that fit over pins on the baseplate. Carefully lift the motor off the baseplate and tilt it. The timing belt will become loose. Remove the timing belt.
10. Remove the motor and encoder.

4.2.3.3 Replacement Procedure

1. If the original lashing tie was discarded, insert a new one through the motor mount.
2. Hold the motor with one hand while installing the timing belt.
3. Fit the motor bracket onto baseplate making sure that the baseplate's pins are engaged.
4. While still holding the motor with one hand, insert the first screw with locking washer to secure the motor bracket to the baseplate. Tighten firmly with the 3/16" balldriver.
5. Insert the remaining three (3) screws with locking washers and tighten with the 3/16" balldriver.
6. Place the lashing tie around the motor.
7. Bring up all of the wires going to the 12-pin Molex connector (see Figure 4-1c) from behind

the motor. Minimize the slack in the wires by bringing them up after the lashing tie between the motor and motor bracket. Shorter wires may be brought up behind the motor just before the lashing tie. Before tightening the lashing tie, make certain that all of the wires are moved out of the way.

8. Tighten the lashing tie. If necessary, use the small size flat screwdriver to push down on the tab until it catches. Cut off any excess and turn the lashing tie until the tab is in the bottom position.
9. Adjust the pins on the motor wires before inserting them into the Molex connector. Each pin has two "wings". Insert the beveled edge of the Molex pin insertion tool between each "wing" and the pin to achieve proper separation.
10. Insert the black motor wire into the pin #9 location of the 12-pin Molex Connector and the white motor wire into the pin #10 location of the same connector. The top of the pin should align with the rounded top of the connector. A click will be heard when the pin has been properly inserted.



Reversing the motor wire pins will not cause any damage, but will cause the motor to work in reverse. After reassembly is complete, power up the Injector and test the Ram. If it retracts when it is supposed to go forward, the motor wires on the Molex connector have to be reversed.

11. Connect the Encoder Ribbon connector to the bottom of the encoder. The number "1" on the connector must be positioned toward the inside of the injector. **Do not reverse the connector on the encoder. This may damage the encoder.**
12. Reconnect the 12-pin Molex connector. A snap will be heard when proper connection is made.
13. Replace the wire tie around Molex wires. Do not allow the wires to bunch up or you will not be able to close the front enclosure.
14. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.4 Replacing Injector's Power Supply

Refer to Figure 4-1a and 4-1e.

4.2.4.1 Required Tools

- ◆ 3/32" balldriver or Allen wrench
- ◆ 5/64" balldriver or Allen wrench
- ◆ 9/64" balldriver or Allen wrench
- ◆ #2 Philips screwdriver
- ◆ 11/32" nut driver

4.2.4.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
2. Disconnect the 16-pin Molex connector and the 12-pin Molex connector. Press on the pin underneath each connector and gently move the connector back and forth to disconnect. The 12-pin Molex connector is part of the Power Supply wire harness.
3. Disconnect the Encoder Ribbon Connector by pulling the connector down from the bottom of the encoder located on the motor. Note the orientation of the connector on the encoder.
4. Disconnect the EDA PCB Harness, if present.
5. Use the 3/32" balldriver to remove the two (2) Power Supply screws labeled W and X in Figure 4-1a. Each screw has a locking washer.
6. Use the 5/64" balldriver to remove the two PCB screws labeled D and E in Figure 4-1e.
7. Use the #2 Philips screwdriver to remove the four (4) screws labeled U, V, Y, and Z in Figure 4-1a.
8. Use the 9/64" balldriver to loosen the screw that secures the Power Supply bracket to the baseplate, but do not remove it. The screw is located beneath the Power Supply bracket. The baseplate is located on the Injector's rear enclosure.
9. Remove the panel support.
10. Follow the procedure for removing the motor (Section 4.2.3.2). Make certain to remove the motor's **black and white wires** from pins #9 and #10 on the 12-pin Molex connector. This is necessary to remove the Power Supply harness. **Do not attempt to remove the harness without removing the motor.**
11. Remove two connectors from pin #7 and pin #12 of the transformer. They are connected to **orange wires** from the Power Supply.
12. Use the 11/32" nut driver to remove the hex nut and washers from the Ground/Earth stud beneath the transformer. Remove the two ground wires. One comes from the 12-pin Molex connector and the other from the 16-pin Molex connector. **Do not remove the remaining nut and ground wire.**
13. Hold the Power Supply while using the 9/64" balldriver to remove the screw holding the Power Supply bracket to the baseplate.
14. Remove the Power Supply with its wire harness.
15. **Do not attempt to remove the transformer. If the transformer is suspect, return the Injector Head to the manufacturer for servicing.**

4.2.4.3 Replacement Procedure

1. Insert the Power Supply with the wire harness into the Injector.
2. Use the 9/64" balldriver to insert the screw that secures the Power Supply bracket to the baseplate. Do not tighten at this time. The Power Supply should be loose.
3. Replace the ground wire from the 16-pin Molex connector followed by the ground wire from the 12-pin Molex connector on the Ground/Earth stud beneath the transformer.
4. Replace the hex nut and washers on the Ground/Earth stud. Tighten with an 11/32" nut driver.
5. Connect the two **orange wires** from the Power Supply to the transformer. The short wire goes to pin #7 and the longer wire goes to pin #12.

6. Run the Power Supply wire harness towards the rear of the Injector behind the motor.
7. Follow the procedure for installing the motor (Section 4.2.3.3). Make certain to reconnect the motor's **black and white wires** to the 12-pin Molex connector. Do not allow the connector's wires to bunch up when replacing the wire tie. Do not get any wires caught inside the motor's lashing tie.
8. Place the panel support into position.
9. Use the #2 Philips screwdriver to insert the four (4) screws labeled U, V, Y, and Z in Figure 4-1a.
10. Use the 5/64" balldriver to replace the button-head screws D and E in Figure 4-1e.
11. Use the 3/32" balldriver to replace the washers and two (2) screws labeled W and X in Figure 4-1a.
12. Use the 9/64" balldriver to tighten the screw that secures the Power Supply bracket to the baseplate.
13. Connect the Encoder Ribbon Connector to the bottom of the encoder. The number "1" on the connector must be positioned toward the inside of the Injector.



Do not reverse the connector on the encoder. This may damage the encoder.

14. Reconnect both Molex connectors. A snap will be heard when proper connection is made.
15. Reconnect the EDA PCB Harness, if required.
16. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.5 Replacing Injector's Power Rocker Switch

Refer to Figures 4-1c and 4-1d.

4.2.5.1 Required Tools

None

4.2.5.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
2. While pushing down or up on the timing belt (see Figure 4-1d), slide the belt off of the top (Ram) sprocket. Remove the timing belt.
3. Disconnect the four (4) wires from the back of the switch. Note how they are connected. This information will be needed when replacing the switch.
4. The top and bottom of the switch have retaining springs. Press down on them and push out.

4.2.5.3 Replacement Procedure

1. Position the rocker switch so that the "o" is on the bottom, and push it through the proper opening in the rear of the back enclosure. The retaining springs will snap when the switch is secure.
2. Reconnect the four (4) switch wires. Refer to your notes to ensure proper connections.
3. Replace the timing belt by placing it first over the bottom (motor) sprocket. While turning the belt, push it onto the top (Ram) sprocket. Ensure that the belt is properly seated on both sprockets.
4. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.6 Replacing Injector's Membrane Panel With Its PCB



Membrane Panel contains two mercury switches. Breakage can result in mercury contamination.

Refer to Figure 4-1b.

4.2.6.1 Required Tools

- ◆ 11/32" nut driver
- ◆ 1/4" nut driver

4.2.6.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
2. Place the Injector's front enclosure face down on a soft, clean surface. Be careful not to scratch or damage the front enclosure's surface or Membrane Panel.
3. Disconnect the plug connector from the front enclosure's PCB by pushing down on the connector and pulling out. Reference section 4.2.7.2 to remove Ribbon Cable.
4. Use the 3/16" nut driver to remove the nut securing the ground wire. Remove the ground wire from the Ground/Earth stud.
5. Use the 1/4" nut driver to remove the ten (10) nuts on the Membrane Panel. Under each nut is a locking washer and flat washer.
6. Gently push up from the front of the enclosure and lift up panel. Be careful not to damage the gasket between the Membrane Panel and the enclosure. Do not remove the clear insulating cover from the top of the PCB.

4.2.6.3 Replacement Procedure

1. Inspect the gasket that lies between the Injector's front enclosure and Membrane Panel. If necessary, replace.
2. Align the Membrane Panel with screws on the front enclosure and place into position.
3. Place the grounding strap on the Ground/Earth stud, if not already done.
4. Place the flat washers, locking washer, and nuts on the ten (10) screws and tighten using the 1/4" nut driver.
5. Install the ground wire and secure with nut using the 3/16" nut driver.
6. Connect the plug connector to the front enclosure's PCB. Reference section 4.2.7.3 to replace Ribbon Cable.
7. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.7 Replacing Injector's Membrane Ribbon Cable

Refer to Figure 4-1b.

4.2.7.1 Required Tools

- ◆ 1/16" balldriver or Allen wrench

4.2.7.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2). The Membrane Ribbon Cable is connected to the front enclosure's PCB. See Figure 4-1b.
2. Place the front enclosure face down on a soft, clean surface.
3. Use the 1/16" balldriver to remove seven (7) screws securing the front enclosure's PCB to seven standoffs.
4. Lift the PCB and remove the Membrane Ribbon Connector. Squeeze the locking tabs on each side of the connector while removing.

4.2.7.3 Replacement Procedure

1. Connect the Membrane Ribbon Connector to the front enclosure's PCB.
2. Place the PCB on the standoffs and secure with seven (7) screws using the 1/16" balldriver.
3. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.8 Replacing Injector's Tone Device (Annunciator)

4.2.8.1 Required Tools

- ◆ 0.050" balldriver or Allen wrench
- ◆ Molex pin extraction tool—11-03-0038 CT or equivalent

4.2.8.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2). The Tone Device is mounted inside the front enclosure below the Pendant Module.
2. The Tone Device shares a plug connector with the large LED mounted on the outside of the front enclosure. Disconnect the plug connector from the front enclosure's PCB.
3. Use the Molex pin extraction tool to remove the Tone Device's two (2) wires from the connector. **Note and record the pin locations of the wires.** You will need this information when replacing the Tone Device.
4. Use the 0.050" balldriver to remove the two (2) screws securing the Tone Device to the front enclosure.

4.2.8.3 Replacement Procedure

1. Insert the Tone Device and replace the two (2) screws. Tighten with 0.050" balldriver.
2. Insert the Tone Device's wires into the plug connector. **Refer to your notes to ensure proper connections.**
3. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.9 Replacing Injector's Syringe Warmer

4.2.9.1 Required Tools

- ◆ Flat blade screwdriver

4.2.9.2 Removal Procedure

1. Disconnect the Syringe Warmer cable from the Injector Head.
2. Unsnap the Syringe Warmer from the syringe.
3. Use the flat blade screwdriver to remove the screw securing the Syringe Warmer to the Injector Head, and remove the Syringe Warmer.

4.2.9.3 Replacement Procedure

1. Position the Syringe Warmer inside Injector bracket just below the syringe.
2. Insert the securing screw through the bracket and tighten with the flat blade screwdriver.
3. Connect the Syringe Warmer cable to the receptacle on the Injector.

4.2.10 Replacing Injector's Syringe Warmer Harness

Refer to Figure 4-1a.

4.2.10.1 Required Tools

- ◆ 3/32" balldriver or Allen wrench
- ◆ 9/64" balldriver or Allen wrench
- ◆ #2 Philips screwdriver
- ◆ 3/4" open end wrench
- ◆ wire cutters

4.2.10.2 Removal Procedure

1. Disconnect the Syringe Warmer cable from the Injector Head.
2. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
3. Disconnect the 16-pin Molex connector and the 12-pin Molex connector. Press on the pin underneath each connector and gently move the connector back and forth to disconnect. The 12-pin Molex connector is part of the Power Supply wire harness.
4. Disconnect the Encoder Ribbon Connector by pulling the connector down from the bottom of the encoder located on the motor. **Note the orientation of the connector on the encoder.**
5. Disconnect the EDA PCB Harness, as required.
6. Use the 3/32" balldriver to remove the two (2) Power Supply screws labeled W and X in Figure 4-1a. Each screw has a locking washer.
7. Use the #2 Philips screwdriver to remove the four (4) screws labeled U, V, Y, and Z in Figure 4-1a.
8. Remove the panel support.
9. While holding the Power Supply, use the 9/64" balldriver to remove the screw holding the Power Supply bracket to the baseplate. The screw has a locking washer.
10. Carefully pull out the Power Supply and allow it to hang.
11. Use the 3/4" open end wrench to loosen the nut securing the Syringe Warmer Harness to the Injector. Space is very tight. Be careful not to cause damage to nearby wires and components. Finish unscrewing the nut by hand.
12. Remove the Syringe Warmer's **green** wire from the Ground/Earth lug.
13. Cut the wire tie that secures the **green** wire to the Power Supply wires. Note the position of the wire tie for replacement purposes (between the transformer and motor).
14. The Syringe Warmer's **red** and **black** wires are wrapped in the same cable that runs to the 12-pin Molex connector. Notice how it lies inside the Injector for replacement purposes.
15. Remove the **red** and **black** wires from pin #12 and pin #1 on the 12-pin Molex connector.
16. Cut the wire tie that secures the Syringe Warmer cable to the other wires. Note the exact position of the wire tie for replacement purposes.
17. Carefully feed the Syringe Warmer Harness to the front of the Injector while removing. Do not allow the harness to snag other wires or components.

4.2.10.3 Replacement Procedure

1. Feed the new Syringe Warmer Harness through the front of the Injector.
2. Position the outside receptacle with the white marking on top and secure with nut on the inside of the Injector.
3. Tighten the nut as much as possible by hand. Finishing tightening using the 3/4" open end wrench. Space is very tight. Be careful not to cause damage to nearby wires and components. Do not over tighten.

4. Connect the harness' **green** wire to the Ground/Earth stud inside the Injector.
5. Use a wire tie to secure the **green** wire to the Power Supply wires. Position it between the transformer and motor.
6. The **red** and **black** wires are wrapped in the same cable. Run it along the bottom of the Injector and bring it up behind the motor to the 12-pin Molex connector. Minimize the slack in the cable. If it is long enough, route it underneath the motor's lashing tie, and bring it up between the motor and the motor bracket. If it is too short, bring it up before the lashing tie.
7. Connect the **black** wire to pin #1 and the **red** wire to pin #12 on the 12-pin Molex connector.
8. Use a wire tie to secure the Syringe Warmer wires to the other wires going to the same Molex connector. Place the tie in the same position as the previous tie. Do not allow the wires to bunch up.
9. Replace the Power Supply. Use the 9/64" balldriver to insert the screw with locking washer that secures the Power Supply bracket to the baseplate. Do not tighten at this time.
10. Place the panel support into position.
11. Use the #2 Philips screwdriver to insert the four (4) screws labeled U, V, Y, and Z in Figure 4-1a.
12. Use the 3/32" balldriver to insert the two (2) screws and washers labeled W and X in Figure 4-1a.
13. Use the 9/64" balldriver to tighten the screw that secures the Power Supply bracket to the baseplate.
14. Connect the Encoder Ribbon Connector to the bottom of the encoder. The number "1" on the connector must be positioned toward the inside of the Injector.



Do not reverse the connector on the encoder. This may damage the encoder.

15. Reconnect both Molex connectors. A snap will be heard when proper connection is made.
16. Reconnect the EDA PCB Harness.
17. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.11 Replacing Injector's Pendant Module

Note: Some Pendant Modules are manufactured with brackets that have tapped holes and are secured to the enclosure with screws. Others have through-holes and are secured with screws, nuts, and locking washers.

Refer to figure 4-1b.

4.2.11.1 Required Tools

- ◆ 11/32" nut driver
- ◆ 1/16" balldriver or Allen wrench
- ◆ Replacement wire ties

4.2.11.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2). The Pendant Module is mounted inside the front enclosure in the rear.
2. Use the 11/32" nut driver to remove the nut from the Ground/Earth stud located inside the front enclosure above the Pendant Module. Remove the Pendant Module's **green** ground wire.
3. If the module is secured to the enclosure with screws only (see the above note), remove the two screws using the 1/16" balldriver. If the module is secured with screws and nuts, hold each inside nut with the 1/4" open end wrench while removing the screw using the 1/16" balldriver. Remove and save the locking washers.
4. Cut and remove the wire ties.

4.2.11.3 Replacement Procedure

1. Insert the Pendant Module in the front enclosure.
2. If the module has brackets with tapped holes, secure to the enclosure with two screws using the 1/16" balldriver. If the module has through-holes, secure using the two screws, nuts, and locking washers. Hold the nut on the inside with the 1/4" open end wrench while tightening the screw with the 1/16" balldriver (see the above note).
3. Connect the Pendant Module **green** ground wire to the Ground/Earth stud and secure with hex nut. Use the 11/32" nut driver to tighten hex nut.
3. Install new wire ties.
4. The Pendant Module's connector will be connected to the Injectors main PCB in the rear enclosure when the front enclosure is replaced.
5. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

4.2.12 Replacing Injector's Hall Effect Sensor

Refer to Figure 4-1d.

4.2.12.1 Required Tools

- ◆ 5/64" balldriver or Allen wrench
- ◆ Small flat blade screwdriver

4.2.12.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
2. Follow the procedure for removing the Injector's main PCB (Section 4.2.2.2).
3. Disconnect the Hall Effect Sensor's plug connector from the plug receptacle on the main PCB at the front of the Injector.
4. Use the 5/64" balldriver to loosen the sensor's set-screw. Refer to Figure 4-1d.
5. Grab the sensor's **red, black, and blue** wires and gently pull out the sensor from the door housing.

4.2.12.3 Replacement Procedure

1. Insert the Hall Effect Sensor into the door housing. **Sensor must be fully inserted.** If necessary, gently tap the sensor with a small flat blade screwdriver.
2. Use the 5/64" balldriver to tighten the sensor's set-screw. Do not over tighten.
3. Connect the Hall Effect Sensor's plug connector to the plug receptacle on the main PCB.
4. Follow the procedure for installing the Injector's main PCB (Section 4.2.2.3).
5. Follow the procedure for installing the Injector's front enclosure (Section 4.2.1.3).

4.2.13 Replacing Injector's Pigtail Cable

Refer to Figure 4-6.

Note: The Injector and Remote Control use similar Pigtail Cables. The Adapter shown in Figure 4-6, however, is used with the Remote Control only and not with the Injector Pigtail Cable.

4.2.13.1 Required Tools

- ◆ Adjustable wrench
- ◆ 11/32" nut driver
- ◆ Molex pin extraction tool—Part No. 11-03-0038 CT or equivalent

4.2.13.2 Removal Procedure

1. Follow the procedure for removing the Injector's front enclosure (Section 4.2.1.2).
2. Disconnect 16-pin Molex connector from main PCB.
3. Use the Molex pin extraction tool to remove all pins from the Molex connector.
4. Use the adjustable wrench to loosen the hex nut inside the rear enclosure.
5. Remove the Pigtail Cable.

4.2.13.3 Replacement Procedure

1. Place the hex nut over the hole inside the rear enclosure with prongs facing down.
2. Insert Pigtail Cable through the hole and hex nut.
3. Use adjustable wrench to secure Pigtail Cable by tightening hex nut.
4. If necessary, use the adjustable wrench to tighten Nut (A) shown in Figure 4-6.
5. Use the beveled edge of the Molex pin extraction tool (or equivalent) to spread the wings on either side of the cable's pins.
6. Connect the cable's pins to the 16-pin Molex connector. Refer to Table 4-1.
7. Connect the Molex connector to the main PCB.
8. Route the cable along the base of the rear enclosure.
9. If all of the repairs have been completed, follow the procedure for replacing the Injector's front enclosure (Section 4.2.1.3).

16-Pin Molex Connector Wiring Table			
Pin No.	Color Code	Pin No.	Color Code
1	Black	9	Not Used
2	Brown	10	White/Orange
3	Red	11	White/Red
4	Orange	12	Not Used
5	Yellow	13	White/Brown
6	Green	14	White/Black
7	Blue	15	Gray
8	Violet	16	White

Table 4-1

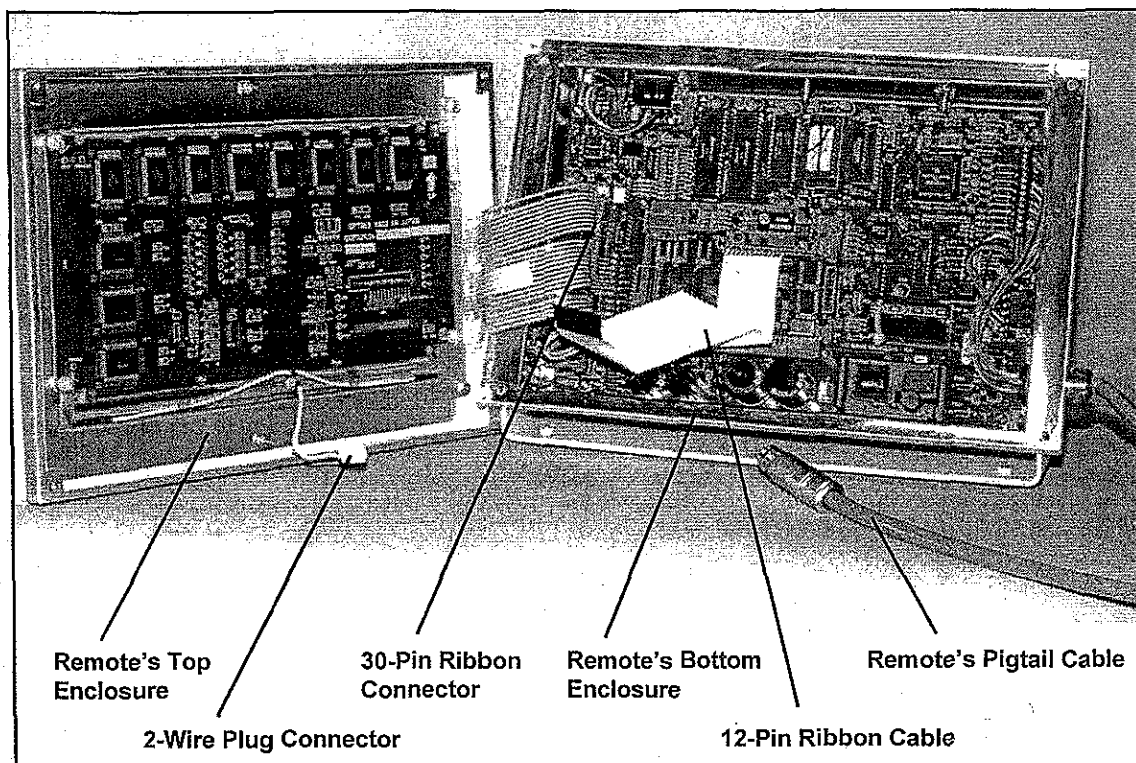


Figure 4-3: Inside the Remote Control

4.3 REMOTE CONTROL



Lethal voltages are present. Before attempting disassembly you must power down the system and remove the AC/Mains power cord from the power source. Failure to comply may result in serious personal injury or death.

Electrostatic Sensitive Devices (ESD) are present. You must wear a wrist grounding strap and place components on an anti-static pad. Failure to comply may result in damage to equipment due to electrostatic discharge.

4.3.1 Separating Remote's Top and Bottom Enclosures

Refer to Figure 4-3.

4.3.1.1 Required Tools

— Small Philips screwdriver

4.3.1.2 Removal Procedure

1. Disconnect the fifty-foot cable from the Remote's pigtail connector.
2. Turn the Remote upside down so that the top enclosure is on the bottom, and place it on a soft, clean surface.
3. Use the Philips screwdriver to remove the four (4) corner screws. One of the screws may be hidden behind a tamper proof label.
4. Grasp the entire assembly, and turn the Remote over so that the bottom enclosure is on the bottom.
5. Slowly tilt the right side of the top enclosure upwards.



There are wires and cables connecting the Remote Control's top and bottom enclosures. Slowly lift the top enclosure and leave enough room to insert your hand to disconnect them. Failure to comply may result in equipment damage.

6. Disconnect the plug connector with the two (2) white wires from the PCB in the bottom enclosure.
7. Disconnect the 12-pin ribbon connector from the top enclosure. The other end of this ribbon is connected to the LCD Driver (small PCB) mounted on top of the larger PCB in the bottom enclosure. Slowly ease out the connector by moving it back and forth. **Note the orientation of the ribbon connector.**

8. Disconnect the 30-pin ribbon connector from the larger PCB in the bottom enclosure.
9. Lift off the top enclosure.

4.3.1.3 Replacement Procedure

1. Place the top enclosure over the bottom enclosure. Tilt the right side of the top enclosure upwards.
2. Connect the 30-pin ribbon connector to the larger PCB on the bottom enclosure. Align the arrow on the connector with pin #1 on the PCB's J2 connector.
3. Connect the 12-pin ribbon connector to the connector in back of the top enclosure. Align the number "1" on the connector with pin number "1" on the enclosure's connector.
4. Connect the plug connector with the two (2) white wires to the plug receptacle on the larger PCB in bottom enclosure.
5. Lie the top enclosure flat on the bottom. Make certain that no wires are sticking out.
6. Turn the Remote around so that the top enclosure is on the bottom.
7. Insert the four (4) corner screws and tighten with the Philips screwdriver.
8. Replace the tamper proof label.

4.3.2 Replacing Remote's Membrane Panel and LCD Display

Refer to Figure 4-4.

4.3.2.1 Required Tools

- ◆ 1/4" nut driver
- ◆ Small Philips screwdriver

4.3.2.2 Removal Procedure

1. Follow the procedure for separating the Remote's top and bottom enclosures (Section 4.3.1.2).
2. Place the top enclosure face down on a soft, clean surface. Be careful not to scratch or damage the top enclosure's surface or Membrane Panel.
3. Use the 1/4" nut driver and remove the six (6) hex nuts labeled C, D, E, F, G, and H in Figure 4-4. Remove and save the washers and Delrin (plastic) shoulder washers.
4. Lift out the entire Membrane/LCD assembly from the top enclosure.
5. Use the Philips screwdriver to remove two (2) screws labeled A and B in Figure 4-4.
6. Very carefully, pull the Membrane Panel and LCD apart. If necessary, use a sharp instrument.

4.3.2.3 Replacement Procedure

1. Place the Remote's top enclosure face down on a soft, clean surface.
2. Re-assemble the membrane panel and LCD display.
3. Insert screws A and B shown in Figure 4-4 and tighten with the Philips screwdriver.
4. Insert the membrane unit inside of the Remote's top enclosure.

5. Install the six (6) Delrin shoulder washers labeled C, D, E, F, G, and H in Figure 4-4. The washers are keyed to permit the smaller circle to fit into the screw openings.
6. Use the 1/4" nut driver to replace the washers and the six (6) hex nuts over screws C, D, E, F, G, and H.
7. Follow the procedure for closing the Remote's top and bottom enclosures (Section 4.3.1.3).

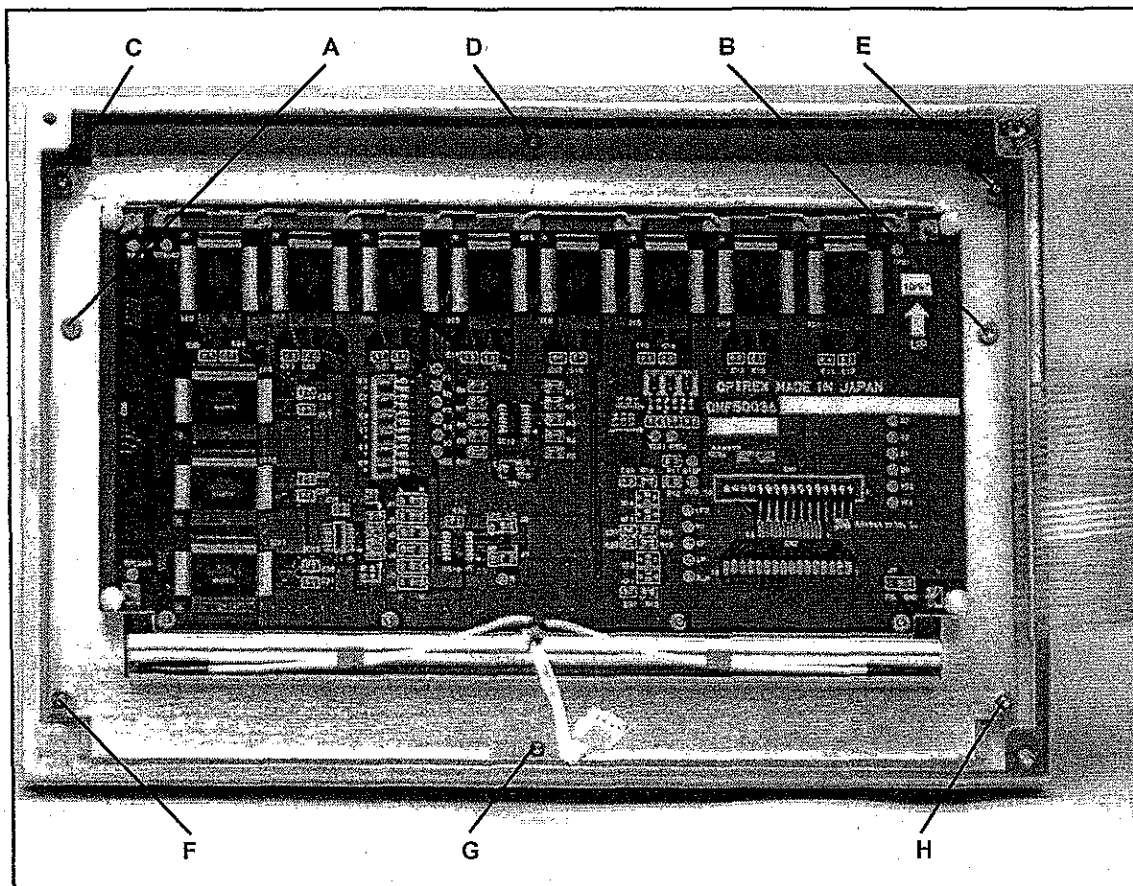


Figure 4-4: Remote's Top Enclosure

4.3.3 Replacing Remote's Main PCB

Refer to Figures 4-5a and 4-5b.

4.3.3.1 Required Tools

- ◆ 1/16" balldriver or Allen wrench
- ◆ 5/64" balldriver or Allen wrench
- ◆ 1/4" open end wrench

4.3.3.2 Removal Procedure

1. Follow the procedure for separating the Remote's top and bottom enclosures (Section 4.3.1.2).
2. Disconnect the three (3) plug connectors labeled A (J3), B (J1), and C (J9) in Figure 4-5a.
3. Use the 5/64" balldriver to remove the six screws labeled D, E, F, G, H, and I. Remove and save the locking washers and the flat washers.
4. Remove the three (3) ground wires from screws D, F, and H in Figure 4-5a.
5. Disconnect the communications wires (part of Pigtail Cable) from pins 1 through 14 on the main PCB's J8 connector.
6. Use the 1/16" balldriver to remove the four corner screws on the LCD Driver. This is the small PCB mounted on top of the main PCB. Remove and save the locking washers and the nylon flat washers.
7. Carefully, nudge the LCD Driver off of the main PCB. There are two connectors (6-pin and 20-pin) on the back of the Driver PCB that are mated to the main PCB.
8. Disconnect the plug connector from the J4 plug receptacle on the main PCB. These are the speaker wires that were hidden underneath the Driver PCB.
9. Use 1/4" open end wrench to unscrew the upper right corner standoff labeled J in Figure 4-5b. Remove and save the nylon washer. **Do not remove the other standoffs.**
10. Lift the main PCB from the bottom enclosure, and push the speaker wires through the hole in the PCB. Note how the wires curve around the speaker and where they come up through the hole. You will need to know this for replacement purposes.

4.3.3.3 Replacement Procedure

1. Place the main PCB inside the Remote's bottom enclosure. Connect the communications wires (part of Pigtail Cable) to pins 1 through 14 on the main PCB's J8 connector. Refer to Table 4-2.
2. Curve the speaker wires around the speaker and pull through the hole in the PCB.
3. Replace the nylon washer and the upper right corner standoff labeled J in Figure 4-5b.
4. Connect the plug connector of the speaker wires to the J4 plug receptacle on the main PCB.
5. Replace the three (3) ground wires on screws D, F, and H in Figure 4-5a.
6. Replace the flat washers, locking washers, and nuts on screws D, E, F, G, H, and I. Tighten with the 5/64" balldriver.
6. Connect the plug connectors labeled A (J3), B (J1), and C (J9).
7. Replace the LCD Driver. Carefully align the 6-pin and 20-pin connectors on the back of the LCD Driver with the mating connector on main PCB. Check if the LCD Driver's screw holes align with the standoff screw holes. Press down on the LCD Driver's four corners.
8. Insert the flat nylon washers, locking washers, and screws into the four corners of the Driver PCB. Tighten using the 1/16" balldriver.
9. Follow the procedure for closing the Remote's top and bottom enclosures (Section 4.3.1.3).

Remote's Main PCB J8 Connector Wiring Table			
Pin No.	Color Code	Pin No.	Color Code
1	Purple	8	Blue
2	Orange	9	White/Red
3	Green	10	White/Orange
4	Brown	11	Gray
5	Black	12	White
6	White/Brown	13	Yellow
7	White/Black	14	Red

Table 4-2

4.3.4 Replacing Remote's LCD Driver PCB

Refer to Figures 4-5a and 4-5b.

4.3.4.1 Required Tools

- ◆ 1/16" balldriver or Allen wrench

4.3.4.2 Removal Procedure

1. Follow the procedure for separating the Remote's top and bottom enclosures (Section 4.3.1.2).
2. Use the 1/16" balldriver to remove the four corner screws and washers on the LCD Driver. This is the small PCB mounted on top of the main PCB.
3. Carefully, nudge the LCD Driver off of the main PCB. There are two connectors (6-pin and 20-pin) on the back of the LCD Driver that are mated to the main PCB.

4.3.4.3 Replacement Procedure

1. Replace the LCD Driver. Carefully align the 6-pin and 20-pin connectors on the back of the LCD Driver with the mating connector on main PCB. Check If the LCD Driver's screw holes align with the standoff screw holes. Press down on the LCD Driver's four corners.
2. Use the 1/16" balldriver to replace the washers and screws into the four corners of the LCD Driver.
3. Follow the procedure for closing the Remote's top and bottom enclosures (Section 4.3.1.3).